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REMARKS

Claims 1, 27 and 32 were rejected under 35 U.S.C. 102(b) as being anticipated by Michelet et al.

In response to the rejection, the applicant amended claim 1 by limiting it further by incorporating the limitations of claims 2, 3, and 15 (partially). Other claims were amended to straighten out the dependency on the cancelled claim 2.

Also, claims 2-19, 22, 28-30 and 31 were rejected under 35 U.S.C. 103(a) as being unpatentable over Michelet et al. and further in view of Boyd et al.

In response to the rejection, the applicant amended claim 1 as explained above.

The present invention is not anticipated or obvious because the zoom system comprises one or more micromirror array lens and the unique features of controllability of the micromirror array lens down to the scale of wavelength of lights are positively utilized to construct the zoom lens system. It is distinctly different from the zoom system of Michelet et al. In detail, the present invention provides a way to solve optical abnormality such as aberration introduced by the spatial arrangement of the micromirror array lenses needed in organizing a zoom system using a reflective optical element, which the system of varying focal length in the reference can never achieve due to the crudeness of the general control and the impossibility of the fine control down to the scale of wavelength of lights. Boyd et al. had not disclosed or implied any way to deal with the aberration caused in the process of setting up the zoom system, either. More specifically, the large amount of aberration associated with the large degree of optical axis offset is possible to correct only with the zoom system with micromirror array lens according to the invention. Such a large aberration cannot be even tried to correct with the system of Michelet et al.

Therefore, the invention is not obvious over the references, Michelet et al. and Boyd et al., in view of MPEP 2143.01, which describes "Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art." Thus, it is not obvious to one of ordinary skill in the art at the time of the invention was made to use the variable focal micro-lens array as taught by Boyd et al. in the well-known zoom optical system.

Also, the invention achieves much more than reducing manufacturing cost by using the micromirror array lenses in the zoom system.

More specifically, it is great advantage that zoom system is compact.

The reflective type zoom system of Michelet et al. (US 4,407,567), more compact than conventional zoom system, is much larger than the present invention. Fig. 2 and Fig. 4 in US 4,407,567 show that the system is large because the control system has complex macroscopic mechanical system. Therefore it is impossible to make compact system using US 4,407,567.

In contrast, Fig. 3a and 3b of the present invention show that the zoom system in the present invention is very simple and compact. Because MMAL is controlled by electrostatic or electromagnetic force, only electronic circuit is necessary to change focal length. Therefore, additional space for control system is not required. This new idea can make this invention to be applicable to many portable devices.

Also, the invention to provide a zoom system that can compensate various optical distortions or aberrations is not obvious to a person having ordinary skill in the art.
To make a compact zoom system, the reflective lens or MMAL should be tilt as shown in Fig. 3b of our invention. This causes large optical distortion and aberrations, which should be compensated by the lens as in the present invention. However, this idea was not described in Boyd et al. The present invention describes this new idea in the paragraph from line 10 of page 15 through line 1 of page 16.

A zoom system that consumes minimal power is not obvious to a person having ordinary skill in the art. While the electrostatic actuator was described in Boyd et al., the applicants invent new idea, which is the zoom system consuming minimal power. Each one idea looks clear, but the combined idea, low power consuming zoom system can not be invented by only ordinary skill.

The compactness, compensation optical distortion and aberrations, and low power consumption of the present invention are great advantages of our invention for the portable device application, and are novel and non-obvious.

In addition, Boyd et al. did not describe how MMAL can change optical axis without macroscopic mechanical movement, and actually it is impossible with MMAL in Boyd et al. And, the zoom system of the present invention enables to get a color image while only a

monochromatic image is possible with Boyd et al. The color imaging is explained in line 2 – 15 of page 5 of the application of the invention.

The new features of the present invention are described as in the following passages of the original specification;

> "The micromirror array lens is possible by controlling only rotation without controlling translation even though it can not satisfy the phase condition. In this case, the imaging quality of the lens generated by controlling only rotation is degraded by the aberration. Pure translation without rotation can satisfy the two imaging conditions by Fresnel diffraction theory. The lens generated by the control of only translation has the aberration too. The smaller the sizes of the micromirror are, the less is the aberration. Even though the quality of the lens with one motion is lower than the lens with rotation and translation, the lens with one motion has the advantage that its control and fabrication is easier than the lens with rotation and translation." (line 12, page 14 – line 2, page 15)

> "The micromirror array lens is an adaptive optical component because the phase of light can be changed by the translations and/or rotations of micromirrors. The micromirror array lens can correct the phase errors as an adaptive optical component can correct the phase errors of light introduced by the medium between the object and its image and/or corrects the defects of a lens system that cause its image to deviate from the rules of paraxial imagery. For an example, the micromirror array lens can correct the phase error caused by optical tilt by adjusting the translations and/or rotations of micromirrors. This allows magnification of any object within the Field of View without macroscopic mechanical motion of some portion of the optical system. Thus, the object to be magnified does not have to lie on the optical axis as in a conventional system." (line 10, page 15 – line 1, page 16)

> "The same phase condition satisfied by the micromirror array lens uses an assumption of monochromatic light. Therefore, to get a color image, the micromirror array lens of the zoom system is controlled to satisfy the same phase condition for each wavelength of

Red, Green, and Blue (RGB), respectively, and the zoom system can use bandpass filters to make monochromatic lights with wavelength of Red, Green, and Blue (RGB).
If a color photoelectric sensor is used as an image sensor in the zoom system using a micromirror array lens, a color image can be obtained by treatments of electrical signals from Red, Green, and Blue (RGB) sensors with or without bandpass filters, which should be synchronized and/or matched with the control of micromirror array lens.
To image the Red light scattered from an object, the micromirror array lens is controlled to satisfy the phase condition for the Red light and Red, Green, and Blue image sensors measure the intensity of each Red, Green, and Blue light scattered from an object. Among them, only the intensity of Red light is stored as image data because only Red light is imaged properly. To image each Green and Blue light, the micromirror array lens and each imaging sensor works in the same manner with the process of the Red light. Therefore, the micromirror array lens is synchronized and/or matched with Red, Green, and Blue imaging sensors." (line 2, page 16 – line 2, page 17)

In summary, the functions needed to construct a zoom system with a reflective optical elements provided only by the micromirror array lens of this invention were to provide still effective correction to the aberration introduced unavoidably by the large off-axis relative disposition of the elements in the process of putting the whole system into a small space.

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CONCLUSION

The applicant believes that the rejections were obviated by the amendment of claims, and the application is now in condition for allowance: therefore, reexamination, reconsideration and allowance of the claims are respectively requested. If there are any additional comments or requirements from the examination, the applicant asks for a non-final office action.

The Commissioner is hereby authorized to charge payment of any additional fees associated with this communication, or credit any over-payment to Deposit Account No. 16-0310.

Very truly yours,
Park & Sutton LLP

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